REMARKS

With this Preliminary Amendment, claims 1, 2 and 7 have been amended, claim 3 has been cancelled, and claims 11-17 have been added. Consideration of the application, as amended, is respectfully requested.

The Director is authorized to charge any fee deficiency required by this paper or credit any overpayment to Deposit Account No. 23-1123.

Respectfully submitted,

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MARKED-UP VERSION OF REPLACEMENT CLAIMS

1. (Amended) A spin valve sensor for use with a data storage system to produce a giant magnetoresistive (GMR) effect in response to applied magnetic fields, the sensor comprising:

a sense current (I), which is horizontally oriented in a longitudinal direction;

a first ferromagnetic free layer having a magnetization (M_1) in a first direction that is aligned in the longitudinal direction of the sense current, when the first ferromagnetic free layer is in a quiescent state;

a second ferromagnetic free layer having a magnetization (M_2) in a second direction that is anti-parallel to the first direction, when the second ferromagnetic free layer is in a quiescent state;

a spacer layer between the first and second ferromagnetic free layers; and

a permanent magnet positioned above the first and second ferromagnetic free layers opposite an air bearing surface (ABS) and ~~biasing component~~ producing a bias magnetization field that biases both M_1 and M_2 in a third direction that is transverse to the first and second directions thereby establishing quiescent bias states for M_1 and M_2; ~~and~~

wherein M_1 produces a first demagnetization field that biases M_2 in the second direction and M_2 produces a second demagnetization field that biases M_1 in the first direction when the first and second ferromagnetic free layers are in their quiescent states, and M_1 and M_2 rotate about their quiescent

bias states in response to an applied magnetic field thereby producing a GMR effect in the sensor as a function of the rotation of M_1 and M_2.

2. (Amended) The spin valve sensor of claim 1, including an insulating layer between the ~~wherein the biasing component is a~~ permanent magnet ~~having a magnetization in the third direction~~ and ~~positioned above~~ the first and second ferromagnetic free layers.

Claim 3 has been cancelled.

7. (Amended) The spin valve sensor of claim 1, wherein M_1 and M_2 are oriented in a direction that is about 45° relative to the sense current when in their quiescent bias states.

Claims 11-17 have been added by amendment.

11. (New) A spin valve sensor for use with a data storage system to produce a giant magnetoresistive (GMR) effect in response to applied magnetic fields, the sensor comprising:

a sense current (I), which is horizontally oriented in a longitudinal direction;

a first ferromagnetic free layer having a magnetization (M_1) in a first direction that is aligned in the longitudinal direction of the sense current, when the first ferromagnetic free layer is in a quiescent state;

a second ferromagnetic free layer having a magnetization (M_2) in a second direction that is anti-parallel to the first direction, when the second ferromagnetic free layer is in a quiescent state;

a spacer layer between the first and second ferromagnetic free layers;

a biasing component including a first anti-ferromagnetic layer exchange coupled to the first ferromagnetic free layer and a second anti-ferromagnetic layer exchange coupled to the second ferromagnetic free layer, the first and second anti-ferromagnetic layers each producing a bias magnetization field that respectively biases M_1 and M_2 in a third direction that is transverse to the first and second directions thereby establishing quiescent bias states for M_1 and M_2; and

wherein M_1 produces a first demagnetization field that biases M_2 in the second direction and M_2 produces a second demagnetization field that biases M_1 in the first direction when the first and second ferromagnetic free layers are in their quiescent states, and M_1 and M_2 rotate about their quiescent bias states in response to an applied magnetic field thereby producing a GMR effect in the sensor as a function of the rotation of M_1 and M_2.

12. (New) The spin valve sensor of claim 11, wherein the third direction is selected from a group consisting of downward and upward.

13. (New) The spin valve sensor of claim 11, including first and second contacts respectively positioned in contact with first and second ends of the first and second ferromagnetic free layers and the spacer layer, wherein the sense current flows between the first and second contacts in the longitudinal direction.

14. (New) The spin valve sensor of claim 13, including:
a bottom shield proximate the first ferromagnetic free layer and the contacts; and
a top shield proximate the second ferromagnetic free layer and the contacts;
wherein the bottom and top shields have a substantially uniform shield-to-shield spacing.

15. (New) The spin valve sensor of claim 11, wherein M_1 and M_2 are oriented in a direction that is about 45° relative to the sense current when in their quiescent bias states.

16. (New) A data storage system including a spin valve sensor in accordance with claim 11.

17. (New) A method of manufacturing a spin valve sensor for use with a data storage system to produce a giant magnetoresistive (GMR) effect in response to applied magnetic fields, the method comprising steps of:
(a) forming a first ferromagnetic (FM) free layer having a magnetization (M_1) in a first direction when in a quiescent state;
(b) forming a second FM free layer having a magnetization (M_2) in a second direction that is anti-parallel to the first direction when in a quiescent state;
(c) forming a spacer layer between the first and second FM free layers;
(d) forming first and second anti-ferromagnetic (AFM) layers on the first and second FM free layers, respectively; the first and second AFM layers having substantially equivalent anneal temperatures;

(e) setting bias fields of the first and second AFM layers simultaneously by cooling the first and second AFM layers through the anneal temperature while applying a magnetic field in a third direction that is transverse to the first and second directions.